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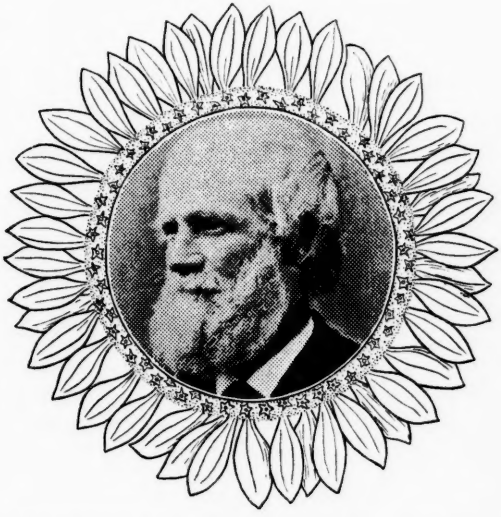

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A REVIEW OF THE BOMBYLIID GENUS HETEROSTYLUM (Diptera)*

BY

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In connection with the description of three new species of **Heterostylum** from Kansas and Texas, a table has been drawn up for the identification of the North American species. Some of the older and less accessible descriptions have been copied or the insects redescribed. Three of the species have been given a place in the table of species from their descriptions only, as they are unknown to me in nature. They are **vierecki** Cresson from Alamogordo, New Mexico and El Paso, Texas; **rufum** (Oliv.) from the West Indies and Brazil, and **pallipes** Bigot from Haiti.

The genus **Heterostylum** may be characterized briefly as follows: Head as broad as thorax; eyes emarginate posteriorly; proboscis nearly equalling the length of the body; antennae approximate at base, first joint quadrate about twice as long as broad, second not much longer than broad, third lanceolate with a short two-jointed style; palpi two jointed; scutellum swollen, semicircular; abdomen as large as or smaller than the thorax, pulvilli present; wings and venation as in **Bombylius;** vein between first M-sub 2 and M-sub 1, small or punctiform. Genotype **Heterostylum flavum** Macq., South America. The types of the new species, unless otherwise stated, are in my own collection.

KEY TO THE SPECIES OF HETEROSTYLUM

1—Scutellum red or light brown 4
—Scutellum black 2
2—Thorax black pilose .....semirufum (Lw.)
—Thorax white or gray pilose 3
3—Face largely black pilose, pile of second abdominal segment largely gray with a few long black hairs .....sackeni (Will.)
—Facial pile white, pile of 2nd abdominal segment black .....**vierecki** Cress.
4—Abdomen with black pile or tomentum 5
—Abdomen entirely yellowish or whitish pilose and tomentose. 9
5—Base of wings brownish into cells R and M, a definite margin present 6

*Contribution No. 375, from the Entomological Laboratory, Kansas State Agricultural College.

—Base of wings infuscated little farther from the base than the arculus; the margin of infuscation indistinct 7

6—Base of wings with a band of red followed by a band of black ..... **stigmatias** Knab.

—Base of wings black with a red spot in the black ..... **rufum** (Oliv.)

7—Pile of thorax black ..... **semirufum** (Lw.)

—Pile of thorax yellow or gray 8

8—Abdomen with two transverse bands of brownish pile; remaining pile yellowish gray ..... **pallipes** Bigot

—Some black pile on most of the abdominal segments; remaining abdominal pile white .... **robustum** (O. S.)

—Abdomen with a little black pile on the sides of segments 2 and 3, remaining pile golden ..... **deani** n. sp.

9—Pile orange yellow ..... **croceum** n. sp.
Pile grayish white ..... **engelhardti** n. sp.

Four other described species are known: **bicolor** v. d. Wulp from Argentine, **ferrugineum** (Fabr.) from Brazil and the West Indies (?); **flavum** Macq. from Brazil; and **xanthobasis** Curran (Amer. Mus. Novitates, No. 339, p. 6, 1929) from Columbia.

Heterostylum semirufum (Lw.)

1872. Loew, H. Diptera Americae septentrionalis indigena, centuria X, 41 **(Bombylius)**.

This species was described from specimens from Haiti. My thanks are due Dr. C. W. Johnson of the Boston Society of Natural History for comparing a specimen from the same locality with the type which is in the museum of Comparative Zoology. **Bombylius hemorrhoicus** Lw. from Cuba is probably also a **Heterostylum** and perhaps conspecific with **semirufum.** The descriptions show differences, however, and the names should remain distinct until specimens can be compared. The latter species is redescribed below:

Ground color black; scutellum reddish brown to blackish; lateroapical angles of second and following abdominal segments reddish; legs brownish black. Antennae: Width of 1st joint 0.2 mm., length 0.48 mm.; width of 2nd 0.16 mm., length 0.2 mm.; width of 3rd 0.16 mm., length 1.20 mm. Third joint linear lanceolate,

the widest place before the middle.

Abdomen black pilose and tomentose, sides of apical two-thirds of second and sides of all the follwing segments long, reddish-yellow pilose. A narrow central stripe of sparse yellowish white tomentum from near base of abdomen to apex of third segment. Wings smoky hyaline, base blackish, costal cell brown. Vein separating 1st M2 and M1 about one-fifth the length of the r-m cross vein. Length male 10 mm., female 12 mm. Redescribed from a male and a female, Haiti, in my own collection.

Heterostylum stigmatia Knab.

1913 Knab, F. Insec. Inscit. Mens. 1: 110-111.

This species is distinguished from most of the other species in the genus by the presence of pictured wings. **H. rufum** (Oliv.) must be quite similar. I have a specimen of **stigmatia** from San Jose, Guatemala, Feb. 5, 1905 collected by Prof. Jas. S. Hine.

Heterostylum sackeni (Will.)

1895 Williston, S. C. North American Fauna. 7;255.

This species was previously known only from the type female in the Snow collection at Kansas University. Williston's description is as follows:

"Female differs from **Comastes robustus** in the smaller size, the presence of black hairs on the face and thorax, the wholly black scutellum, which is without bristles on its margin, in the abdomen being rather uniformly clothed with shorter white pile, intermixed with numerous long black hairs, and in the greater infuscation of the basal portion of the wings. The femora and tibiae are black. Length 9 mm. One specimen, Argus Mountains, Calif., May 1892."

The following notes were taken on examination of the type. Ground color black, grayish pollinose; grayish white pilose with long black hairs on the posterior margins of the segments. The infuscation of the wings rather indefinite.

A male in the collection of Jas. S. Hine, although much smaller (6 mm. in length), agrees well with the type female in all characters except those due to difference in sex. It carries the data "S. Cala", only. It is designated an androtype. The long black hairs on the abdomen are perhaps not as conspicuous as in the female, and the wings at the base are somewhat more darkly tinged with brown.

Heterostylum robustum (O. S.)

1877. Osten Sacken, C. R. Western Diptera. Bull. U. S. Geol. Sur. III: 257 (Comastes)

1886. Osten Sacken, C. R. Biologia Centralia Americana Diptera I, p. 151.

1903. Snow, F. H. Kans. Univ. Sci. Bul. 2:214,

Osten Sacken's description is as follows:

"**Comastes robustus** n. sp., female—Ground-color of the head grayish-white, yellowish round the mouth, densely clothed with pale yellowish-white pile, more yellow on the front; a tuft of black pile on the ocellar tubercle. Antennae black; first joint grayish-pruinose. Palpi reddish, second joint brownish. Proboscis black. The dense pile on the vertex is yellowish above, whitish below. The grayish-black ground-color of the thorax is almost concealed on the dorsum by a dense, short, erect clothing of fulvous pile; on the pleurae, a tuft of whitish-yellow hair; that on the chest almost white. Scutellum reddish, with fulvous pile and some black bristles along the edge. Abdomen blackish gray; second segment with a short, appressed tomentum, forming a yellowish-white cross-band; the remaining segments, beginning with the posterior margin of the second, are covered with long, semi-erect, black pile, across which, in the middle of the abdomen, there is a triangular figure formed by similar pile, but white; the apex of the white triangle rests on the hind margin of the second segment; the oblique stripes of white pile, forming the sides of the triangle, run downward toward the venter; the inner side of the triangle is filled, partly with black, partly with white pile, the latter chiefly occupying the end of the abdomen; the venter is clothed anteriorly with white, posteriorly with black pile. Legs reddish; tarsi darker; hind tibiae and tarsi reddish-brown. Knob of halteres yellow. Wings grayish-hyaline; base as far as the basal cross-veins brownish; costal cell pale yellowish. Length 11-12 mm.

Hab.—Waco, Texas (Belfrage). A single female. The specimen is in Mr. E. Burgess's collection in Boston."

The male differs principally in having less conspicuous cross bands of white tomentum on the abdomen.

The variation in the amount of black on the abdomen is considerable. Usually there is black pile on every segment, including the base of the second and the apical half of the venter. The third joint of the antennae is linear lanceolate, but not greatly expanded

in the center; greatest width 0.2 mm., length 1.28 mm., the style yellowish brown. The first antennal joint and legs vary in color from black to red. Specimens vary in length from 8 to 12 mm. In some specimens from western Kansas and Estancia, New Mexico, the black pile is confined to the apical and lateral margins of the second and third segments, and the center of the third and fourth. The pile of the thorax and venter is sometimes light yellow. These specimens appear to intergrade into the usual form and are hence retained in this species.

The species is relatively common in Texas. I have taken it at Brownwood, Lorain, Port Lavaca, Austin, Junction, and Colorado. At Brownwood they were taken on alfalfa June 16, where their usual peculiar hum aided in their capture. I have seen specimens from Brownsville, Texas, Clarksville, Miss. (Aug.), Douglas and Florence, Ariz., and Mississippi County, Ark. (Sept.). The species has been collected in Barber, Comanche, Dickinson, Finney, Geary, Hamilton, Harper, Marshall, Mead Phillips, and Sumner counties, Kansas. A female collected at Irving, Kansas, in July, was hovering over and apparently ovipositing in a Bembex burrow. It is on the wing in Texas from May through September.

Heterostylum deani n. sp.

Female. Ground color opaque. Black, face, posterior angles of thorax, scutellum and legs except tarsi, underside and tips of femora reddish; each joint antennae. greatest width 0.22 mm.; length of first 0.6 mm., of second 0.22 mm., of third 1.4 mm. Third joint linear, tapering toward the tip.

Golden yellow tomentose and pilose; beneath head, on sternite and on sides of second abdominal segment whitish. Setae on second antennal joint and second joint of palpi black; on first antennal joint brownish black. Tomentum black on base of second dorsal segment of abdomen, a small area in the center of third and fourth, and on the sides of third; pile black on sides of second and third, and ventral part of fourth, fifth and sixth; pile white on ventral part of second and third segments. This white pile extends up on the side of second to some extent.

Legs yellowish tomentose, that below on the femora, black; spines black. Wings hyaline, base and costal cell yellowish; vein separating first M2 and M1 about one-half as long as r-m cross vein. Length 12 mm.

Holotype female, two paratype females (the latter in rather poor condition). Mitchell County, Kansas, August 25, 1903. G. A. Dean collector. Accession number 2138. "General collecting on weeds around Waconda Springs". Two paratype females in the collection of Jas. S. Hines, one; "Manhattan, Kansas, August 9, 1921; R. C. Smith coll." the other, "Berkeley, Calif., 8-20-98." The species is named in honor of the first recorded collector, Prof. Geo. A. Dean.

The species differs from **H. robustum** principally in the color and distribution of the pile and tomentum of the abdomen. In **robustum** the vein mentioned is punctiform, or less than one-fourth as long as the r-m crosvein. There is some variation in the color of the legs.

Heterostylum croceum n. sp.

Male.—Ground color bluish black, red or yellowish on face, palpi except tips, scutellum, sides of second, third, and fourth abdominal segments, legs except tips and front of femora, all of tibia, tarsi and genitalia. Antennae; width of first joint 0.16 mm., length 0.40 mm.; width of second joint 0.13 mm., length 0.20 mm., width of third joint 0.12 mm., length 1.08. Third joint linear, tapering toward the style which is yellow.

Bright yellow pilose and tomentose; pile on ocellar tubercle brownish, the second joint of the antenna and tip of palpus with a few black setae. Tomentum of legs the same color as the ground color, spines black. The tomentum or appressed pile on the abdomen sparse and confined to the hind margins of the segments and a line down the center of the abdomen.

Wings hyaline base yellowish, vein separating first M2 and M1 punctiform. Length 9 mm.

Female similar to male but with the usual sexual differences.

The dorsum of thorax and abdomen is clothed with thick, appressed pile or tomentum. The ground color of the first segment of antennae and the entire abdomen may be largely or wholly yellowish, especially in female. Length 11 mm.

Holotype female, Medora, Kansas, sand dunes, July 3, R. H. Painter, collector; allotype and one paratype from same place, July 4. Another paratype female Austin, Texas, R. H. Painter collector, June 26; and 6 females; 1 male paratypes, Ballinger, Texas, June 15, Sand dunes, E. M. and R. H. Painter, collectors. Five females, three males, paratypes in the Kansas Univ. col-

lection from Barber, Graham, Norton, Osborn, Pratt, Rooks. Sumner, and Trego Counties, Kansas; collected by R. H. Beamer and F. X. Williams in July and August. Five abraded specimens from Clay county, Missouri, in the same collection are apparently the same species.

Heterostylum engelhardti n. sp.

Female ground color black; grayish pollinose; face, first joint of antennae, palpi except tips, post alar callosities, scutellum, apex of abdominal segments second and third and legs reddish; first antennal joint width 0.2 mm., length 0.48 mm., second joint same width, length 0.21 mm., third joint lanciolate, when viewed from the side wider than in **H. robustum,** width 0.32 mm., length 1.24 mm.

Pale yellowish white tomentose and pilose; setae of second antennal joint black; tomentum of legs white; bristles of thorax and scutellum yellow. Legs yellow, extreme apex of femur and spines black. Wings hyaline tinged with yellow at base and along costa. Length 12 mm.

Holotype female; San Antonio, Texas, April 19, 1928; G. P. Engelhardt, collector.

The species is similar to **H. robustum,** but differs in the shape of the antennae and color of the pile. It is named in honor of the collector.

THE BIOLOGY OF OPSIUS STACTOGALUS FIEBER (Homoptera, Cicadellidae)

LEONE HARDING, Lawrence, Kansas.

Taxonomic History

Opsius stactogalus Fieber has had rather a restless position taxonomically. According to Olsen (1), "it has been shifted to and fro, and described in various genera, and in one case a genus was erected for it which was subsequently withdrawn, and these species put in an old and well known genus."

The insect was described in this country by Doctor E. D. Ball (2) as **Eutettix Osborni** from examples taken by F. H. Snow in Galveston, Texas in 1907. No food plant is mentioned. Some years later, September 1920, while he was calling at the American Museum of Natural History in New York City, he found specimens of the insect on Tamarix near the Museum, though they had been known thus far to occur only in Texas and California, also on Tamarix. Mr. Olsen also secured speci-

mens of the hopper and on trying to have the Tamarix species determined, he found the plant was an European importation. Thinking the hopper might have been imported with the host, Mr. Olsen sent specimens to E. de Bergevin of Algiers, requesting him to compare them with European leafhoppers. Bergevin identified the so called **Eutettix Osborni** Ball as **Athysanus stactogalus** Fieb. In the meantime Olsen received a box in exchange from Mr. V. Lallemand of Brussels, Belguim containing the same little leafhopper also labeled **Athysanus stactogalus** Fieber.

In going over the available literature, Olsen found that Amyot in 1847 had described the insect briefly as **Stactogala** (3), neglecting to use the binomial nomenclature. Fieber (1866) erected the genus Opsius for Amyot's Stactogala (4). Thus the species becomes a Fieberian one, as Amyot's name could not stand through disregard of the Zoological rules. Fieber later (1872) seemed to regard his new genus synonymous with Athysanus, for in his "Katalog der europaeischen Cicadinen" he lists the insect in the genus Athysanus (5) Jassus, Thamnotettix, Opsius and Limnotettix are given as synonyms. From that time on the hopper was known in European literature as **Athysanus stactogalus** Amyot. Oshanin (1912) lists the insect as **Athysanus stactogalus** giving credit for the first time to Fieber (6). Therefore, the American **Eutettix Osborni** Ball determined by two European specialists as Athysanus, becomes a synonym for **Athysanus stactogalus** Fieber, Athysanus being considered a subgenus of Euscelis. Ball (1929) in his key to the American genera of the old group Athysanus (Euscelis of the Van Duzee catalogue) omits stactogalus Fieb. Making a note that it belongs to the genus Opsius Fieber and that **Opsius stactogalus** its type is much more closely related to Eutettix than it is to Athysanus. (7).

Hosts

Opsius stactogalus has been taken a number of places in the United States and with one exception Tamarix sp. has been given as the host plant. Gibson and Cogan (1915) reported the hopper on "white aster used in ornamental planting (8)." Olsen (2) suggests that "it would be exceedingly interesting to know if the insects lived and thrived on this plant or if they were only casual visitors from a nearby Tamarix as both plants are extensively used in ornamental planting."

The most common Tamarix species in eastern Kansas is **Tamarix gallica.** It is native to the Mediterranean region and has been under cultivation since 1596 (9). This species has been found in the United States for a number of years. It has become naturalized in Southern Texas and New Mexico, and has also been found growing wild along the Arkansas River in Kansas and Colorado.

Tamarix africana is a species much less common in Kansas than **Tamarix gallica,** as it is not so thrifty in this climate. All the specimens of **africana** in this locality were infested with **Opsius stactogalus,** but the number of the insects was small compared with the thousands living on a single plant of **T. gallica.** The little pale green nymphs and adults are conspicuous against the bright green foliage and purple stems of **T. africana,** but scarcely noticeable against the glaucous green background of **T. gallica.**

Although many of the shrubs were so infested with thousands of the active little hoppers that they seemed to be alive with them, there was no noticeable damage to the shrub itself. **Tamarix gallica** has a luxuriant growth, particularly after it has been cut back previous to the growing season. It must be thrifty to support its own growth apparently unharmed as well as furnish sap for the thousands of little beaks which are daily inserted for food. The practice of trimming back the shrubs to within eighteen inches of the ground every other year keeps the number of hoppers down, as the larger per cent of the overwintering eggs which are usually laid in the small branches, are destroyed.

Number of Generations

Observations in the field from the first of May to the last part of November indicate that there are three generations of **Opsius stactogalus** a year. The eggs for the first generation are laid in the fall and hatch the next spring. The last adults of that generation were gone by June 29. First instar nymphs of the second generation were found in the field on the same date. The first adults appeared July 18. The last of the fifth instar nymphs of that generation were taken August 14. There was no time between the second and third generations when adults were not to be found, as there was between the first two generations, but there was a period from August 20 to September 6 when there was a decided decrease in the number of individuals. This dis-

crepancy is explained by the difference in the lengths of the egg stage for the second and third generations. The average length of time for the egg stage of the second generation was 18.2 days. This was doubtless due to the weather. At the time the second generation eggs were developing in June, the weather was cool and rainy. The temperature during August was much higher and the length of the egg stage, averaging 11.3 days, was reduced. Consequently, the adults of the third generation appeared before those of the second generation had all disappeared.

Technique For Rearing

The nymphs of **Opsius stactogalus** are small and very active. Their pale green coloring is so near that of their host **Tamarix gallica** that finding one on a given stem is a difficult matter. In order to keep the little fellows in the laboratory so that they might be readily observed, it was necessary to keep them confined, each in a one dram glass vial, plugged with cotton. During the first part of the season the older nymphs did very well with a small piece of Tamarix stem of convenient size inserted twice daily for food. This method proved unsatisfactory for the small nymphs and for the older ones during the hot part of the season for the stem soon wilted and the nymphs were unable to get sap from them. The nymph was placed in a vial on the tip of a Tamarix twig, from eight to ten inches long and the mouth of the vial then plugged with cotton. The other end of the stem was placed in a small jar filled with water. The vial was allowed to rest on a box, a cigar box proving to be a satisfactory height, or on the table if the length of the stem permitted. Part of the leaves were stripped from the portion of the stem which was not confined in the bottle to prevent too rapid transpiration and the wilting of the branch. It was necessary to be careful not to strip off too many leaves as moisture would gather inside the bottle, which favored fungous growths on the insects. The stems were changed daily.

The adults were kept in larger cages. Stems of Tamarix ten to twelve inches long were inserted several inches into four inch flower pots filled with sand, which was kept wet. The insects were confined on the stem by a number two lamp chimney, the top of which was covered with cheese cloth. This method was not entirely satisfactory. The adult hoppers were so active that a good many, the males particularly, escaped while

the food was being changed.

Emergence In Spring

Opsius stactogalus overwinters in the egg stage. The first nymphs probably appeared during the first week in May, 1928 and continued to emerge for the next two weeks. During the spring of 1929 the first nymphs were found May 9. The nymphs go thru five instars, which takes approximately a month.

DESCRIPTION AND LENGTH OF STAGES

The Egg

Length 0.75 mm.; width 0.33 mm.; Elongate ovate, tapering to a point at one end, the other rounded; white in color, somewhat transparent, with the surface smooth.

Length of Egg Stage

Second generation, average 18.6 days.

Number Eggs	Laid	Hatched	Time
1	June 14	July 3	19 days
1	June 16	July 4	18 days
1	June 16	July 4	18 days
1	June 16	July 5	19 days
1	June 16	July 5	19 days

Third generation, average 11.3 days.

Number Eggs	Laid	Hatched	Time
2	August 8	August 17	9 days
4	August 8	August 18	10 days
6	August 9	August 21	12 days
5	August 12	August 24	12 days
1	August 12	August 24	13 days
2	August 12	August 26	14 days
1	August 12	August 27	15 days
6	August 15	August 27	12 days
17	August 17	August 29	12 days

First Instar

Size: Average length 0.81 mm.; width across eyes 0.35 mm.

Color: The newly hatched nymph, pearly white with reddish brown eyes. By the second day, abdomen slightly yellow; third day nymph uniformly pale yellow or yellowish green.

Length of Stage Average 6.16 days.

Number of Nymphs	Hatched	1st Molt	Time
1	July 4	July 10	6 days
4	August 10	August 16	6 days
1	August 13	August 19	6 days
2	August 17	August 24	7 days
1	August 18	August 24	6 days
1	August 19	August 25	6 days
1	August 21	August 28	7 days
1	August 24	August 30	6 days
2	August 27	September 2	6 days
1	August 27	September 3	7 days
10	August 29	September 4	6 days

Second Instar

Size: Average length 0.96 mm.; width across eyes 0.43 mm.

Color: Pale green, white or light median dorsal stripe running the full length of the body. Yellow area on anterior and lateral margins of vertex, lateral margins of pronotum and outer edges of the wing pads. Eyes brown.

Length of Stage Average 5.92 days.

1st Molt	2nd Molt	Time
July 7	July 14	7 days
July 9	July 16	7 days
July 10	July 16	6 days
July 12	July 18	6 days
July 12	July 18	6 days
July 24	July 30	6 days
July 24	July 30	6 days
August 2	August 8	6 days
August 3	August 9	6 days
August 4	August 10	6 days
August 16	August 21	5 days
August 16	August 21	5 days
August 16	August 22	6 days
August 16	August 22	6 days
August 24	August 31	7 days
August 27	September 1	5 days
August 27	September 3	7 days
August 27	September 3	7 days
August 28	September 4	7 days
August 30	September 4	5 days

September 2	September 8	6 days
September 4	September 9	5 days
September 4	September 10	6 days
September 6	September 11	5 days

Third Instar

Size: Average length 1.25 mm.; width across eyes 0.56 mm.

Color: Same as for second instar. In addition there are four longitudinal rows of white dots on the abdomen, two on either side of the mid-dorsal line, one row near the lateral margin of the abdomen and the other halfway between the lateral row and the mid-dorsal line. There are also white flecks on the vertex and wing pads. In many individuals there is an area of dark brown stippling toward the lateral edges of the last three abdominal segments.

Length of Stage Average 6.4 days.

2nd Molt	3rd Molt	Time
July 7	July 15	8 days
July 8	July 15	7 days
July 10	July 17	7 days
July 10	July 17	7 days
July 15	July 21	6 days
July 15	July 21	6 days
July 15	July 21	6 days
July 17	July 25	8 days
July 18	July 25	7 days
July 18	July 25	7 days
August 21	August 27	6 days
August 21	August 28	7 days
August 22	August 28	6 days
August 22	August 29	7 days
August 23	August 28	5 days
September 1	September 8	7 days
September 1	September 7	6 days
September 3	September 8	5 days
September 3	September 10	7 days
September 4	September 10	6 days
September 8	September 14	6 days
September 9	September 14	5 days
September 11	September 16	5 days

Fourth Instar

Size: Average length 2.19 mm.; width across eyes 0.86 mm.

Color: Same as third instar. Stippling found on lateral margins of the last five abdominal segments, on the first pair of wing pads, the medio-caudal area of the prothorax, median and lateral areas of the vertex. Small dark brown triangle on caudal margin of the second pair of wing pads, slightly more than halfway from the mid-dorsal stripe to the lateral edge.

Length of Stage Average 6.54 days.

3rd Molt	4th Molt	Time
July 8	July 15	7 days
July 15	July 22	7 days
July 15	July 22	7 days
July 15	July 22	7 days
July 22	July 29	7 days
July 25	August 1	7 days
July 25	August 1	7 days
August 5	August 11	6 days
August 17	August 23	6 days
August 21	August 27	6 days
August 21	August 28	7 days
August 21	August 27	6 days
August 27	September 3	7 days
August 28	September 3	6 days
August 28	September 4	7 days
August 28	September 4	7 days
August 29	September 5	7 days
September 4	September 10	6 days
September 7	September 13	6 days
September 8	September 14	6 days
September 14	September 20	6 days
September 16	September 22	6 days

Fifth Instar

Size: Average length 3.06 mm.; width across eyes 1.2 mm.

Color: Same as fourth instar. Stippling on all the abdominal segments but not confined to the lateral margins on the last five segments. Wing pads heavily stippled on the lateral portions, giving them a brownish appearance. Stippling also on median and lateral portions of prothorax and vertex.

Length of Stage Average 6.83 days.

4th Molt	5th Molt	Time
June 7	June 14	7 days
June 8	June 16	8 days

June 13	June 20	7 days
June 13	June 20	7 days
June 13	June 20	7 days
June 15	June 23	8 days
June 22	June 30	8 days
August 1	August 7	6 days
August 6	August 12	6 days
August 23	August 30	7 days
August 27	September 2	6 days
August 27	September 2	6 days
August 28	September 4	7 days
September 3	September 10	7 days
September 3	September 10	7 days
September 4	September 11	7 days
September 4	September 11	7 days
September 13	September 20	7 days
September 14	September 21	7 days
September 14	September 20	6 days
September 20	September 27	7 days
September 22	September 28	6 days
September 22	September 28	6 days

Adult

Deep green, the elytra with milky flecks and smoky apices.

Size: Female 4.5 mm.; male 4 mm.

Structural Characteristics:

Head: Distinctly wider than prothorax. Vertex two and one-half times as wide as long, slightly longer at middle than next the eye, broadly rounding to front. Front broad, margins of clypeus parallel.

Pronotum: Twice as long as vertex, two and one-third times as wide as long, anterior margin broadly convex, posterior margin slightly concave, lateral margins greatly reduced, humeral margins distinct.

Scutellum: Normal

Elytra: Distinctly longer than abdomen, closely folded giving a wedge-shaped appearance to the insect, venation rather obscure, especially apically.

Genitalia: Last ventral segment of female three times as long as preceding, posterior margin produced medially with very slight median notch; visible portion of pygofer two and one-half times length of last ventral segment, sparsely spined; ovipositor approximately the same length as pygofer. Male valve equilaterally tri-

angular, three-fourths the length of last ventral segment; plates long, tapering, acutely pointed, exceeded but slightly by pygofer, lateral margins with long hairs.

Color: Eyes dark brown. Vertex and anterior portion of prothorax pale green, often yellowish-green, posterior half of prothorax deep green. Scutellum yellow, transverse depression black, frequently two to four dark spots along anterior margin. Elytra deep green to just beyond the dark apex of the clavus, then smoky, subhyaline, often dotted with white flecks; costa with lighter area in region of costal plaque, two smaller light areas posteriorly, the three light areas separated by darker costal spots. On some individuals minute black dots on elytra, prothorax and vertex. Face and venter pale green.

MATING AND OVIPOSITION

Mating may take place anytime after the insects become adult. Pairs in copulation may be found in the field almost anytime that adults are present. The preoviposition period varied from 7 to 12 days in those individuals which were kept in the laboratory. The average time was 10.3 days.

Female Became adult	First Eggs	Time
July 23	August 3	11 days
July 23	August 4	12 days
July 26	August 7	12 days
July 28	August 4	7 days
July 28	August 7	10 days
August 2	August 12	10 days

Eggs are placed beneath the bark of younger stems and branches and beneath the epidermis of the small green shoots. They are usually placed in an oblique position but are often found transversely across the stem. When ovipositing, the female rests her body on the first two pairs of legs, the ovipositior is unsheathed, brought down perpendicularly to the stem and inserted in it about half of its length, with small pushing movements. The average time for the process is one minute. The number of eggs laid by one female in the laboratory was 53 in an oviposition period of 10 days. Another laid 58 eggs in a period of 13 days. The number of eggs laid per day by the two is as follows:

Female Number 1			Female Number 2		
July 23	Became adult.		August 30	Became adult.	
August 4	4	eggs.	September 10	3	eggs.
August 5	3	eggs.	Septembed 11	4	eggs.
August 6	3	eggs.	September 12	3	eggs.
August 7	10	eggs.	September 13	7	eggs.
August 8	17	eggs.	September 14	7	eggs.
August 9	5	eggs.	September 15	10	eggs.
August 10	6	eggs.	September 16	6	eggs.
August 11	1	egg.	September 17	6	eggs.
August 12	2	eggs.	September 18	4	eggs.
August 13	2	eggs.	September 19	3	eggs.
August 14	0	eggs.	September 20	2	eggs.
August 15	0	eggs.	September 21	0	eggs.
August 16	0	eggs.	September 22	3	eggs.
August 17	0	eggs.	September 23	0	eggs.
August 18	0	eggs.	September 24	0	eggs.
August 19		dead.	September 25	0	eggs.
			September 26		dead.

On many of the shrubs there were only a few individuals of the first generation, due to trimming back the shrub which destroyed many of the overwintering eggs, and to the activity of parasites the previous fall. There was a great increase in numbers for the second generation. At the time of maximum abundance of the third generation individuals, the shrubs were alive with them. This great increase in spite of the presence of parasites indicates a fairly high rate of productivity.

LONGEVITY OF ADULTS

The adults of **Opsius stactogalus** live one month on an average. Field observations from the time the first adults of a generation appeared (July 18) until the decrease of their numbers (August 20), or from the time the last nymphs were found (October 10) until the last adults disappeared (November 15) indicate the length of life to be close to a month. The maximum period for individuals reared in the laboratory was 38 days for females, one becoming adult on June 12 and living until July 20, and 29 days for males, one becoming adult July 24 and living until August 22.

DISAPPEARANCE IN THE FALL

Adults were found in large numbers until the middle of October. There was a gradual decrease until the

first of November. Examinations were made daily. A few hoppers could always be found during the next two weeks, usually feeding on the larger branches. Hoppers were last seen alive November 15. There was a cold rain on November 16 and 17, and a heavy frost the night of the 18th. No live hoppers could be found on November 19.

NATURAL ENEMIES

Throughout the summer, eggs of lace wing flies (Chrysopidae) were common on the Tamarix. The larvae were often seen running up and down the stems, searching for food. There were no aphids on the shrubs, and thinking the nymphs of **Opsius statogalus** might be the prey of the chrysopid larvae, a number of nymphs were caged in a small vial with one of the larvae, resulting in the destruction of the nymphs. The larva was reared to an adult, fed on nymphs of the hopper.

A single fifth instar nymph was taken June 13, which had been parasitized by one of the Hymenopterous parasites, a Dryinid. The parasite appeared as a small dark sac hanging from between the mesothorax and methathorax, on the lateral side. The nymph lived nine days, which was past the time when it normally would have molted, without doing so. It died June 22. Two fifth instar nymphs were found on October 2 which had been similarly parasitized. They lived only two more days. The Dryinid larvae left the dead bodies of their hosts. They were very active, crawling on their backs by peculiar peristaltic movements, searching for a place to make their cocoons. They were put in vials half full of dirt. The larvae immediately crawled beneath the surface of the soil and by the next day were spinning their overwintering cocoons. The Dryinidae would be effective parasites of **Opsius stactogalus** Fieb. if they occurred in large enough numbers. Only three parasitized specimens were found among the hundreds of nymphs that were brought into the laboratory from the field.

The most effective enemy of the Tamarix leafhopper is the chalcid fly **Polynema saga** Girault, belonging to the family Mymaridae. This species had been known only from the type specimen in the United States National Museum, taken by H. S. Barber at Washington, D. C., in 1905, until discovered in large numbers by Dr. P. B. Lawson on the University of Kansas campus during the summer of 1927.

The females of this minute egg parasite could be seen running up and down the branches, with their antennae constantly feeling the surface of the stem to locate the host eggs which appear externally as small blister-like swellings. Having found a suitable location the fly places herself lengthwise of the egg, inserts her ovipositor leaving her own tiny egg within that of the host egg. She then continues her search. The adults were seen occasionally during August, but were not numerous until the early part of October. By that time the Tamarix stems were almost covered with the hopper eggs and the activity of the parasites was very noticeable.

Early in November while dissecting eggs of **Opsius stactogalus,** one specimen was noticed in which movements of the yolk material could easily be discerned even before the egg was completely uncovered. When removed to a watch crystal and covered with a drop of normal saline, the semitransparent egg showed within it the white larva of **Polynema saga.** The larva was quite active, the most common movement being that of the cephalic end lashing back and forth, causing churning movements of the yolk material.

The pupal stage of **Polynema saga** is also passed within the shell of the hopper egg. The adult emerges through a round hole at the larger end of the egg which it cuts with the mouthparts, bit by bit, until it is large enough to admit emergence.

Over 90% of the overwintering eggs of the Tamarix leafhopper were parasitized during the fall of 1927. Counts of the eggs on stems taken at random for the year 1928 showed but a little over twenty five per cent parasitism. Occuring in large numbers and attacking the egg stage of its host, **Polynema saga** destroys a much larger proportion of individuals of **Opsius stactogalus** than do its other enemies.

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PLATE I

1. Egg.
3. 2nd Instar.
4. 3rd Instar.
5. 4th Instar.
6. 5th Instar.
7. Adult.
8. Eggs in Situ.

PLATE II.

1. Inner Valve of Ovipositor.
2. External Genitalia—Female.
3. Internal Genitalia—Male.
4. Left Clasper.
5. External Genitalia—Male.
6. Tip of Abdomen—Male.

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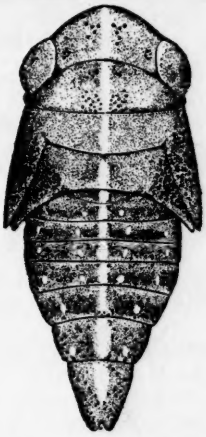

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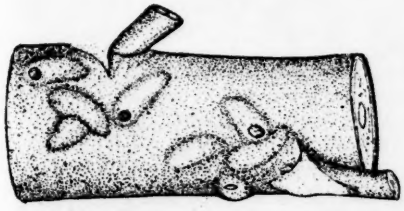

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PLATE I.

(21)

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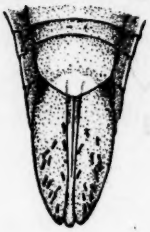

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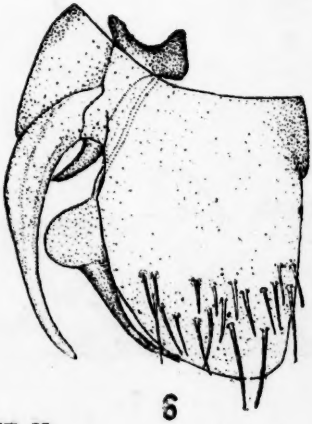

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PLATE II.

THREE NEW VELIA FROM SOUTH AMERICA

By

H. B. HUNGERFORD, University of Kansas, Lawrence.

In several of the European museums which I visited last year I found in the undetermined material a small Velia which I could not name and decided that since its size is no greater than that of the largest Microvelia known to me it might prove to have been described as such. I therefore brought the specimens with me for determination and now, upon further study, discover that there are three closely related forms undescribed.

Velia rotundanotata species new.

Size: Length 4 mm.; width across eyes .68 mm.; width across humeri 1.15 mm.

Color: General color light brown, the body sparsely clothed with darker bristle-like hairs and the head, thorax and margin of connexivum with minute peg-like points that are most noticeable on the humeral elevatiins. Anterior portion of pronotum with two large irregularly triangular frosty patches. A pale median longitudinal line on pronotum and a short one at the base of each humeral elevation. Pale transverse marks on the segmental lines of the connexivum. In the wingless individuals there is a large circular frosty spot on the median line of each of the last three dorsal abdominal segments. In the winged forms there is a white triangular stripe at the base of each wing and a conspicuous, nearly circular spot in the middle of the membrane. Hemelytra, margin of connexivum and third segment of antenna darkest. Venter with lateral bands of gray bloom. Legs and two basal antennal segments a little lighter than the body. The last antennal segment, except at tip, lighter than the others—horn color.

Structural characteristics: This is a shorter species than **Velia stagnalis** Burm. Vertex of head elevated, front long. Antenna longer than half the body. Antennal formula: 1st: 2nd: 3rd: 4th: :3.75: 2.8: 3.5: 4.5. First Antennal segment somewhat curved and its tip when directed backward surpassing the head; the tip of the third segment surpassing the rear margin of the pronotum at least in the wingless form. The first segment a little larger in diameter than the others. Legs of moderate length; hind legs longest, the front ones shortest, the front femora equal or greater in diameter than the others. Front tarsus about half as long as front tibia, the distal tarsal segment a little stouter and

about as long as the other two together. The distal segment of the middle tarsus nearly as long as other two together; in the hind tarsus the distal and middle segments are equal in length. The pronotum constricted before the humeri, which are elevated, the transverse depressions marked. Surface of pronotum pitted, median longitudinal carina marked in front.

Sixth ventral abdominal segment of the male without marked protuberances.

Described from fifteen specimens, two males and thirteen females. There are five winged forms in the lot. They are labeled "La Plata" and came by way of the Breddin collection to the Deutsches Entomologische Museum in Berlin-Dahlem where I was permitted to study them by Doctor Walther Horn. In addition to the above I have seen nine specimens of this species from Minas Geraes in the Museum at Copenhagen.

The types are in the Deutsches Entomologische Museum. I have some specimens belonging to the British Museum that have the same general facies and which I supposed to be the same species. The males, however, have conspicuous divergent protuberances on the last ventral abdominal segment that are lacking in the species described above and this lead me to make a more critical examination of the series.

Velia confusa species new.

Size: Length 5 mm.; width of head .88 mm.; width of humeri 1.9 mm.; thus slightly larger than the preceding species.

Color: Lighter and more yellowish in color than **Velia rotundanotata.** The hemelytra with white line on the corium continuing from the basal white spot. The margin of the clavus with a more conspicuous white spot. The circular white spot on the membrane as in the preceding species. The distal antennal segment not lighter in color than the other segments.

Structural characteristics: Readily distinguished from the preceding by the less elevated humeri and by the conspicuous projections of the so called sixth ventral abdominal segment of the males.

Antennal formula: 1st: 2nd: 3rd: 4th: : 4.5: 3.75: 5:5.2.

Vertex a little less elevated than in preceding species. Body covering the same as described for the preceding species. Described from two males and a female from Brazil—all winged—two are labeled "Para"

and one "Amazon." The holotype and allotype are in the British Museum.

Velia williamsi species new.

Size: Length 6 mm.; width across the eyes 1.2 mm.; width across humeri 2.3 mm.

Color: Light chocolate brown—a pale tan stripe on the base of each hemelytra—triangular in shape and extending to near the tip of the scutellum. A round pale spot on the membrane. Coxae, trochanters and basal half of femora testaceous. Venter same color as dorsum.

Structural characteristics: A plump bodied insect resembling in ground color, general shape and body covering **Velia platensis** Berg. but with a body not as thick dorso-ventrally and with elevations of the last ventral abdominal segment of the male (pregenital) resembling more closely those of **Velia basalis** Spinola. These elevations are relatively longer but less prominent in this new species than in **Velia basalis** Spinola. Head short. Pronotum with low median longitudinal carina—surface sparsely punctured—no wider than the head in front, the margins diverging to the humeri and slightly concave. Humeri but slightly elevated and rear margin of pronotum thickened. Hemelytra exposing the tip of the last genital segment in female. Underside of body slightly flattened in female.

Abdominal venter flattened and even depressed in the male, the so called sixth ventral abdominal segment produced caudally into two stout blunt nearly parallel protuberances that are separated by a space nearly equal to twice their diameter. Genital clasper of male as shown in the figure.

Antennae imperfect in all my specimens but the formula for the first three segments is as follows: 1st: 2nd: 3rd: :4.4: 4-: 4.5. First segment thicker than the others and curved, its distal end surpassing the head when the antenna is directed backwards. The third segment very slender, its tip surpasses the humeri when antenna is directed backward. Beak short, scarcely attaining base of middle coxae. Legs short, hind ones longest, front ones shortest, not provided with spines. The third tarsal segment slightly longer than the second in the middle and hind tarsi.

Described from four specimens—one male and three females taken by Doctor F. X. Williams, near New

Amsterdam, British Guiana, July 30, 1923.

Notes: This species belongs to the Paravelia subgenus of the genus Velia. Here belong **Velia basalis** Spinola **basalis** Spinola than to **Velia platensis** Berg. **Velia** and **Velia platensis** Berg. It is much closer to **Velia platensis** Berg. by its shape reminds one of **Angilia albidotinola** Stal. from Madagascar. It does not have as short a head or as long a pronotum as the Madagascar insect—neither are the basal tarsal segments so long.

PLATE I.

Three New Velia—H. B. Hungerford.

Figure I. Left genital clasper of male of **Velia basalis.**

Figure II. Left genital clasper of male of **Velia williamsi** sp. new.

Figure III. Right genital clasper of male of **Velia platensis.** This clasper was removed from the specimen and turned to show its unusual shape.

Figure IV. Ventral view of genital segments of the male of **Velia platensis.**

Figure V. Left genital clasper of **Velia platensis.**

Figure VI. Ventral view of genital segments of the male of **Velia rotundanotata** sp. new.

Figure VII. Left genital clasper of male of **Velia rotundanotata** sp. new.

Figure VIII. Ventral view of genital segments of the male of **Velia williamsi** species new.

Figure IX. Ventral view of genital segments of the male of **Velia confusa.**

Figure X. Left genital clasper of male of **Velia confusa** sp. new.

Figure XI. Ventral view of genital segments of the male of **Velia basalis.**

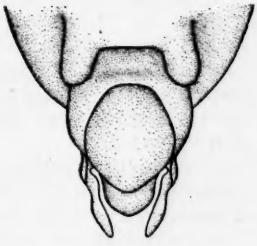
Velia basalis (L. clasper).

Velia williamsi (L. clasper).

Velia platensis (R. clasper).

Velia platensis (male abd. venter).

Velia platensis L. clasper).



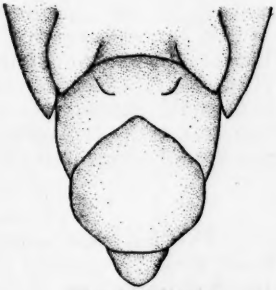
Velia williamsi (male abd. venter)

Velia retundanotata (male abd. venter)

Velia retundanotata (L. clasper).

Velia confusa (male abd. venter)

Velia confusa (L. clasper)



Velia basalis (male abd. venter)

PLATE I.

BRIEF NOTES ON MEXICAN INSECTS

H. H. NININGER, McPherson College.

During a three-months tour in Mexico the writer had occasion to make a few insect notes which may be of interest to the readers of the Journal.

On Oct. 15 in Saltillo—a city of 60,000, swarms of the small butterfly **Libythea carinento** drifted thru the streets and over the buildings ahead of a storm in such abundance that for two hours the air was so filled with them that one could see from 50 to 1000 at any moment. As we drove south from the city the same day they were found abundantly to a distance of 40 miles. The same day at a point about ten miles from the city, in a small short-grass pasture bordering a corn field, **Tenebrionidae** of the genera **Eleodes** and **Asida** were so abundant that one could pick up six or eight without changing his position. They were crawling aimlessly over the grass.

In the state of Guanajuato along the road several species of **Phanaeus, Aphodius** and other Scarabs were found in numbers under the droppings of burros, cattle and Mexicans. Their brilliant coloring and large size rendered their collection a pleasing diversion from the nerve-racking monotony of bumping along over Mexican "roads."

A large spring flowing from the foot of a small mountain some 30 miles east of Torreon, in the midst of a wide expanse of desert furnished an ideal situation for the collection of water insects. A number of species were taken. Here also were taken a series of a species of **Tetracha** which were plentiful under the stones at the water's edge. Tiger beetles of several species were collected at Tuxpan, near Ruis on the S. P. R. R. in the state of Nyarit, and at Mazatlan on the coast.

It is perhaps worthy of notice that in none of the hotels did we encounter an infestation of bed-bugs. However the familiar spectacle that a protracted search for small game on each-other's heads, so frequently engaged in by the natives convinced us that we were not always at a safe distance from other pests.

NOTE

The halftone within the circle on the cover design is of Prof. Benjamin F. Mudge, the first professor to teach Entomology at the Kansas State Agricultural College. The first course was given in the year 1866-'67. Professor Mudge was born August 11, 1817, at Orrington, Maine. He died Nov. 21, 1879, at Manhattan, Kansas.

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NOTE

After January 1, 1930, Volume I will be sold to those who wish it at $2.00 per volume. There are only a few complete sets of this volume in the hands of the Society.

Volume III, No. 1, January, 1930, Mailed January 3, 1930.